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Integration of CUF micromechanics framework into NASMAT for multiscale analysis of fiber-reinforced composites

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The paper deals with the integration of micromechanics framework developed within the scheme of Carrera Unified Formulation (CUF) into NASA Multiscale Analysis Tool (NASMAT), a new state-of-the-art multiscale framework developed at the NASA Glenn Research Center. NASMAT is intended to be an open-platform, multiscale modeling framework for use on high performance computing systems. Although NASMAT already includes several semi-analytical micromechanics theories [1], one of the primary software development goals behind NASMAT is interoperability with other research and commercial codes. The current work demonstrates the integration of a fully-numerical model, CUF, into the NASMAT framework. The CUF micromechanics framework can effectively capture nonlinear behavior of composite at microscale through component-wise modeling technique. The CUF models are able to resolve accurate three-dimensional strain and stress fields at a reduced computational cost, for instance, approximately one to two orders of magnitude of degrees of freedom less as compared to standard 3D brick elements [2]. Figure 1 compares the transverse stress fields (σ_{22}) for different micromechanics model within NASMAT, namely HFGMC (High-fidelity Generalized Method of Cells) and CUF, for square-packed RVE under transverse tension loading. A numerical

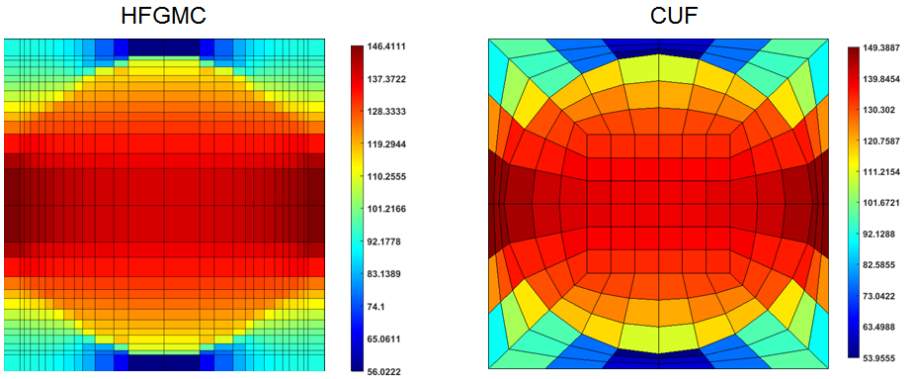

Figure 1: Comparison of transverse stress fields (σ_{22}) under transverse loading condition for different micromechanics models within NASMAT

simulation campaign, including prediction of effective mechanical and thermal properties

of RVE and local resolution of stress fields, shall be undertaken to verify and evaluate the accuracy and efficiency of CUF models in comparison to analytical and semi-analytical micromechanics model within NASMAT.

References

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